May 13, 1947. C. H. BACHMAN 2,420,561

ELECTRON MICROSCOPE STRUCTURE

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Fig. 1.

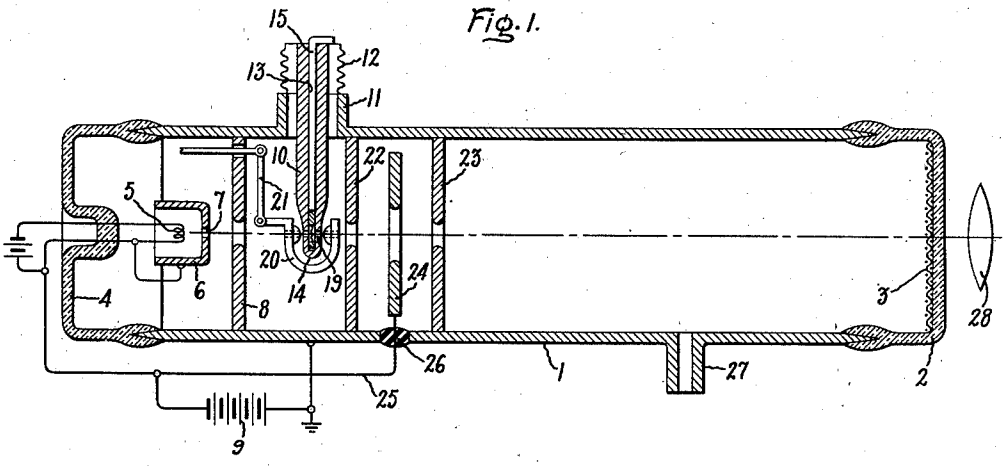
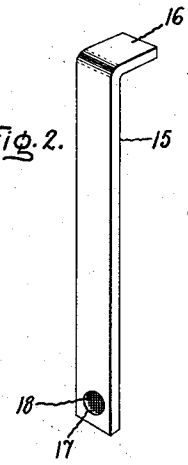


Fig. 2.



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ELECTRON MICROSCOPE STRUCTURE

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3 Claims. (Cl. 250—49.5)

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My invention relates to electron microscope structure and in particular to a new and improved apparatus for introducing specimens to be examined into an evacuated electron microscope chamber.

It has long been a problem in electron microscopy to obtain suitable means for introducing specimens into an evacuated chamber. In the usual practice, substantial loss of vacuum results whenever change in specimens is made. Substantial improvement in operating conditions and also substantial decrease in time between subsequent observations may be expected if specimens may be introduced both without loss of vacuum and without shutting down the vacuum system used and disconnecting the power supply. Accordingly, it is an object of my invention to provide a new and improved specimen insertion apparatus for electron microscopes by which specimens may be replaced without substantial loss of vacuum within the main microscope chamber.

Another object of my invention is to provide a new and improved specimen insertion apparatus for an electron microscope which is sealed by a slide containing the specimen to be observed.

It is a still further object of my invention to provide a new and improved electron microscope structure in which specimens to be observed may be changed without removing the power supplied to the electrodes of the microscope.

One of the features of my invention consists of the use in an electron microscope of a thin specimen-carrying slide which fits into a narrow slot in a resiliently supported member, the slide serving to close the slot and seal the evacuated chamber of the microscope from atmospheric pressure. The resilient mounting of the slide-carrying member permits adjustment of the specimen by means of a manipulator so that it lies in the path of an electron beam and is traversed by the beam to obtain a magnified picture of the specimen.

Another object of my invention is to provide a new and improved electron microscope structure in which no valves are required for inserting specimens to be examined into a vacuum chamber and in which a vacuum pump is operated continuously while a specimen is being inserted.

The features of the invention which are desired to be protected herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the drawing in which Fig. 1 represents a cross-sectional view of an electron microscope suitably embodying the invention and Fig. 2 is a view of the specimen-carrying slide employed in the microscope structure of Fig. 1.

Referring particularly to Fig. 1, there is shown

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an electron microscope comprising an elongated vacuum-tight container which consists mainly of a cylindrical metal part 1 closed at one end by a transverse glass wall 2 which is provided on its inner surface with a screen 3 coated with fluorescent particles and adapted to form an image under the impact of electrons. At the opposite end of the microscope there is provided a glass insulating structure 4 which serves to support an electron source in the form of a filamentary cathode 5. The cathode 5 is surrounded by an apertured cup-shaped member 6 having a narrow slit or opening 7 which confines the emitted electrons to a narrow beam and which is cooperatively positioned with respect to a diaphragm 8 supported in contact with the main envelope part 1. In the normal use of the apparatus, the envelope 1 and the electrode 8 are maintained at ground potential, while the cathode is held at several thousand volts below ground by a potential source, represented by the battery 9, so that electrons emitted from the cathode are projected toward the window 2.

Between the cathode 5 and the image reproducing screen 3 there is provided an object or specimen supporting means which comprises a small tube 10 extending into the envelope 1 and which is resiliently supported from a neck portion 11 connected to envelope 1 by means of a flexible sealing member 12. The member 12 may comprise, for example, a Sylphon bellows or a corrugated rubber sleeve. The tube 10, which may be formed of metal, is provided with a longitudinal rectangular slot 13 which is open at its upper end to the atmosphere and which is closed at its bottom end by a rounded portion 14 of the tube 10. Removably supported within the slot 13 is a slide or specimen holder 15 which is machined to provide a precision fit within the slot 13. The slide or specimen carrier 15, as shown in Fig. 2, is an inverted L-shaped member, the leg portion 16 of the L providing means for withdrawing the slide from the slot 13. Near its lower end the slide 15 is provided with an aperture 17 in which is positioned a supporting screen 18 on which may be placed a specimen to be observed. Near its lower end the metallic member 10 is provided with a transverse aperture comprising two tiny holes 19 which are opposite to each other and open to the slot 13 in such a position that an electron beam coming from the cathode 5 passes through the openings 19 in the metallic member 10 to transradiate an object supported on the screen 18 of the slide 15.

There is also provided a manipulator 20 which may be operated by means of a linkage 21 and an external operating means, not shown, to contact the resiliently mounted tube 10 to adjust the position of the lower portion of the tube so that the openings 19 and the opening 17 in the

slide 15 fall in the path of the electron beam passing between the cathode 5 and the fluorescent screen 3. Such a manipulator may be of the type described in my joint copending application Serial No. 468,676, filed December 11, 1942, and assigned to the same assignee as the present application. The manipulator 20 may be used to move the apertures 19 in three mutually perpendicular directions to position the specimen to be examined in the path of the electron beam of the microscope and in a desired position with respect to the electron lens system now to be described.

Between the specimen tube 10 and the screen 3 there are provided one or more electron lens systems for exerting a refractive force upon the electron rays proceeding from the specimen under investigation. While these lens systems may be of the magnetic or electrostatic type or any combination of these two types, they are shown in Fig. 1 as being of the electrostatic type and comprise a pair of apertured metal diaphragms 22, 23, which are maintained at ground potential by a connection to the envelope 1, and an intermediate diaphragm 24, which is insulated from the member 10 and connected to the cathode potential by means of a lead-in conductor 25 which extends through an insulating bushing 26. The chamber 1 of the microscope structure may be evacuated by any suitable means, such as a vacuum pump, not shown, connected to a tubulation 27 formed in the walls of the metallic container 1.

In the operation of my electron microscope, a specimen to be observed is placed on the screen 18 within the slide 15 and the slide is inserted in the slot 13 of the tube 10. By means of the manipulator 20 the holes 19 and the specimen are positioned so that an electron beam coming from the cathode passes through the two small holes 19 to transradiate the specimen and then enters into the electron lens. The electron beam is refracted by the electron lens and passes onto the fluorescent screen 3 to form an enlarged image of the specimen under observation. The image on the fluorescent screen may be further enlarged by means of a light microscope which is represented generally as the lens 28 located outside of the electron microscope in front of the end window 2. The small holes 19 opening into the vacuum chamber are of the order of a few mils in diameter and, together with the long leakage path formed between the walls of the slot 13 and the slide 15 machined to make a close fit to these walls, are made to constitute such a slow leak of air that no valves or locks are necessary and the vacuum pumps used for evacuating the chamber 1 need never be disconnected from the chamber even when the slide 15 is withdrawn. By utilizing a plurality of slides and quickly inserting a new slide when one is withdrawn from the slot 13, not only is it unnecessary to shut off vacuum pumps, but also the potentials applied to the cathode and the electron lens system may be left connected during a specimen insertion period.

It is apparent, therefore, that by this improved construction the customary valves and locks used in electron microscopy are eliminated and the operation of an electron microscope to permit examination of objects is expedited to the extent

that vacuum conditions are maintained almost continuously and no shutdown is required for changing specimens. Likewise potentials may be applied continuously to the electrodes of the microscope.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electron microscope comprising an evacuated chamber, means within said chamber for projecting an electron beam, and means for supporting an object to be examined in the path of said beam, said means comprising a tubular member extending into said chamber, said member having a longitudinal slot therein and a transverse aperture communicating with said slot and positioned in the path of said beam, a slide member adapted to fit in said slot and support a specimen to be observed across said aperture, said aperture being minute in size and said aperture and said slot forming a slow air leak between the inner and outer surfaces of said chamber when said slide is removed from said slot.

2. The combination, in an electron microscope having an evacuated chamber, of a flexibly mounted member extending into said chamber, said member having a longitudinal slot therein and a transverse aperture communicating with said slot, means for positioning said member to place said aperture in alignment with an electron beam of said microscope, said aperture being minute in size and said aperture and said slot forming a long leakage path between the inner and outer surfaces of said chamber having a slow rate of leakage, and a specimen carrier adapted to fit into said slot and to place a specimen to be observed across said aperture, said carrier having a close fit with the walls of said slot to block substantially air flow through said path.

3. A specimen support for an electron microscope having an evacuated chamber comprising a tubular member extending into said chamber, said member having a longitudinal slot and a transverse aperture communicating with said slot, a slide adapted to fit in said slot and to prevent leakage of air through said slot and said aperture when in position, said slide having a hole in alignment with said aperture and said aperture being of minute size and said slot being of sufficient length to form a slow leakage path for air between the inner and outer surfaces of said chamber during periods when said slide is removed from said slot.

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